Chapter B7: Alternative Options - Costs and Economic Impacts

Introduction

EPA considered the costs and economic impacts of four alternative regulatory options that would establish best technology available (BTA) for minimizing adverse environmental impact (AEI):[1]

- **(1) Waterbody/Capacity-Based Option (Options 1 and 2):** This option would require Phase II facilities located on estuaries, tidal rivers, and oceans to reduce intake capacity commensurate with the use of closed-cycle, recirculating cooling systems based on the volume of cooling water they withdraw. EPA analyzed two different cases of the waterbody/capacity-based option: the first case assumes that all facilities with recirculating cooling system-based requirements would comply with Track I and install a wet cooling tower (Option 1); the second, more likely, case assumes that a percentage of the facilities with recirculating cooling system-based requirements would comply with Track II and conduct a comprehensive waterbody characterization study and install technologies other than wet cooling towers (Option 2).

- **(2) Impingement Mortality and Entrainment Controls Everywhere Option (Option 3a):** This option would require all Phase II facilities to reduce impingement and entrainment to levels established based on the use of design and construction technologies (e.g., fine-mesh screens, fish return systems) or operational measures.

- **(3) All Cooling Towers Option (Option 4):** This option would require all Phase II facilities to reduce intake capacity commensurate with the use of closed-cycle, recirculating cooling systems.

- **(4) Dry Cooling Option (Option 5):** This option would require Phase II facilities located on estuaries, tidal rivers, and oceans to reduce intake capacity commensurate with the use of a dry cooling system based on the volume of cooling water they withdraw.

For each of these four alternative options, this chapter presents (1) the private annualized costs of compliance by NERC region and plant type;[2] (2) cost-to-revenue ratios at the facility and firm-levels; and (3) an analysis of potential impacts on small entities. The methodologies used to develop the estimates presented in this chapter are the same as those discussed in previous chapters of this EBA. *Chapter B1: Summary of Compliance Costs* and the *§ 316(b) Technical Development Document* present EPA's detailed analysis of the compliance cost components and national cost estimation; *Chapter B2: Cost*

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[1] *Chapter A1: Introduction and Overview* of this Economic and Benefits Analysis (EBA) provides a more detailed discussion of the requirements of these alternative regulatory options. EPA also considered another waterbody-based option (Option 6) in which all facilities located on an estuary or tidal river or ocean must reduce intake flow commensurate with a level that can be achieved by a closed-cycle, recirculating system, regardless of proportional intake flow. This option was not costed and is not discussed in this chapter.

[2] For a count of Phase II facilities by NERC region and plant type, see *Chapter A2: Need for the Regulation* of this EBA.

Impact Analysis presents an assessment of the magnitude of compliance costs at the facility and firm-levels; and *Chapter B4: Regulatory Flexibility Analysis* considers the potential impact of the proposed Phase II rule on small entities.

B7-1 Waterbody/Capacity-Based Option (Options 1 and 2)

The waterbody/capacity-based option would require facilities that withdraw very large amounts of water from an estuary, tidal river, or ocean to reduce their intake capacity to a level commensurate with that which can be attained by a closed-cycle, recirculating cooling system. EPA estimates that 54 facilities would be required to reduce intake flow to a level commensurate with that which can be attained by a closed-cycle recirculating system to comply with this option.

The cost for facilities to meet these standards could potentially be substantial if they installed a cooling tower. Under this option, EPA would provide an opportunity to seek alternative requirements to address locally significant air quality or energy impacts. While EPA is not proposing this option, EPA is considering it for the final rule.[3]

EPA analyzed two different cases of the waterbody/capcity based option: the first case assumes that all 54 facilities with recirculating cooling system-based requirements would comply with Track I and install a wet cooling tower; the second, more likely, case assumes that 33 facilities would comply with Track I and install a wet cooling tower and the remaining 21 facilities with flow reduction requirements would comply with Track II and conduct a comprehensive waterbody characterization study and install technologies other than wet cooling towers.

B7-1.1 Compliance Costs

EPA estimates that the total annualized private post-tax cost of compliance for the waterbody/capacity-based option ranges from approximately $379 million assuming 21 facilities comply with Track II (Option 2) to $595 million assuming all 54 facilities comply with Track I (Option 1).

Table B-2 presents the total annualized private costs by cost category and NERC region for both of the compliance responses analyzed. The NERC regions with the highest compliance costs, FRCC (Florida Reliability Coordinating Council), MAAC (Mid-Atlantic Area Council), NPCC (Northeast Power Coordinating Council), SERC (Southwestern Electric Reliability Council), and WSCC(Western Systems Coordinating Council) all contain coastal states with facilities withdrawing cooling water from estuaries, tidal rivers, or oceans.

Using the assumption that all 54 facilities with recirculating cooling system based requirements would comply with Track I (Option 1), the annualized cost by NERC region ranges from approximately $90,000 for facilities located in ASCC (Alaska Systems Coordinating Council) to $142 million for facilities located in NPCC (Northeast Power Coordinating Council). The capital technology cost, which includes the cost of cooling towers, comprises $226 million of the total $595 million cost (or 38 percent). The annual energy penalty and one-time connection outage costs represent $68 million (or 11 percent) and $26 million (or 4 percent), respectively. Annual operating and maintenance costs represent $242 million (or 41 percent) of total compliance costs. Permitting costs represent $34 million (or 6 percent) of total compliance costs.

Under the second, more likely, assumption that some facilities would comply with Track I and others with Track II (Option 2), the annualized cost by NERC region ranges from approximately $76,000 for facilities located in ASCC (Alaska Systems Coordinating Council) to $98 million for facilities located in NPCC (Northeast Power Coordinating Council). The capital technology cost comprises $162 million of the total $379 million cost (or 43 percent). The annual energy penalty and one-time connection outage costs represent $28 million (or 7 percent) and $22 million (or 6 percent), respectively. EPA estimates operating and maintenance costs to be $146 million (or 39 percent) of total compliance costs. Permitting costs represent $32 million (or 8 percent) of total compliance costs.

[3] EPA analyzed this option using the energy market model. For a detailed analysis, see *Chapter B8: Alternative Options - Electricity Market Model Analysis* of this Economic and Benefits Analysis (EBA).

Table B7-2: Private (Post-Tax) Annualized Compliance Costs by NERC Region (in millions, $2001) Waterbody/Capacity-Based Option

NERC Region	One-Time Costs		Recurring Costs		Permitting Costs	Total
	Capital Technology	Connection Outage	O&M	Energy Penalty		
All Track I (Option 1)						
ASCC	$0.0	$0.0	$0.0	$0.0	$0.1	$0.1
ECAR	$15.2	$0.0	$3.6	$0.0	$5.9	$24.6
ERCOT	$8.5	$0.4	$12.2	$2.7	$3.5	$27.2
FRCC	$29.7	$5.4	$44.2	$15.3	$2.1	$96.7
HI	$5.5	$1.1	$5.4	$2.5	$0.2	$14.8
MAAC	$40.7	$3.2	$45.9	$9.1	$2.5	$101.4
MAIN	$6.4	$0.0	$1.4	$0.0	$3.0	$10.8
MAPP	$2.0	$0.0	$0.4	$0.0	$3.0	$5.3
NPCC	$54.7	$4.6	$66.2	$12.7	$3.8	$141.9
SERC	$27.5	$3.5	$28.1	$10.5	$5.9	$75.6
SPP	$1.3	$0.0	$0.4	$0.0	$2.1	$3.8
WSCC	$34.0	$7.3	$34.3	$15.1	$2.3	$93.0
Total	**$225.5**	**$25.5**	**$242.1**	**$67.9**	**$34.3**	**$595.3**
Track I and II (Option 2)						
ASCC	$0.0	$0.0	$0.0	$0.0	$0.1	$0.1
ECAR	$15.2	$0.0	$3.6	$0.0	$5.0	$23.7
ERCOT	$7.7	$0.3	$10.3	$2.0	$3.1	$23.3
FRCC	$18.5	$0.9	$24.5	$3.7	$2.2	$49.7
HI	$5.5	$1.1	$5.4	$2.5	$0.2	$14.7
MAAC	$23.8	$1.1	$22.5	$3.1	$2.6	$53.2
MAIN	$6.4	$0.0	$1.4	$0.0	$2.5	$10.3
MAPP	$2.0	$0.0	$0.4	$0.0	$2.5	$4.9
NPCC	$40.0	$2.5	$45.8	$6.2	$3.9	$98.4
SERC	$20.7	$1.6	$13.4	$3.8	$5.4	$45.0
SPP	$1.3	$0.0	$0.4	$0.0	$1.8	$3.5
WSCC	$21.1	$3.5	$17.7	$7.0	$2.5	$51.8
Total	**$162.0**	**$11.0**	**$145.5**	**$28.4**	**$31.7**	**$378.6**

Source: U.S. EPA analysis, 2002.

Table B7-3 presents total annual facility compliance costs by cost category and steam plant type. The annual compliance costs under Option 1 range from $2 million for waste facilities to $232 million for oil and gas facilities. Under Option 2, total annual compliance costs range from $2 million for waste facilities to $189 million for oil and gas facilities

Table B7-3: Annualized Facility Compliance Costs by Steam Plant Type (in millions, $2001) Waterbody/Capacity-Based Option

Steam Plant Type	One-Time Costs		Recurring Costs			Total
	Capital Technology	Connection Outage	O&M	Energy Penalty	Permitting Costs	
All Track I (Option 1)						
Coal	$65.3	$5.3	$58.0	$17.6	$18.3	$164.6
Combined Cycle	$7.6	$0.4	$10.7	$1.3	$1.0	$21.1
Nuclear	$67.7	$14.3	$62.3	$27.4	$3.4	$175.2
Oil/Gas	$84.1	$5.4	$110.1	$21.5	$11.0	$232.1
Waste	$0.7	$0.0	$0.9	$0.2	$0.5	$2.3
Unspecified	$0.0	$0.0	$0.0	$0.0	$0.1	$0.1
Total	**$225.5**	**$25.5**	**$242.1**	**$67.9**	**$34.3**	**$595.3**
Track I and II (Option 2)						
Coal	$42.5	$0.5	$16.9	$2.1	$16.5	$78.5
Combined Cycle	$7.6	$0.4	$10.7	$1.3	$0.9	$20.9
Nuclear	$38.8	$5.9	$29.7	$10.2	$3.6	$88.2
Oil/Gas	$72.4	$4.0	$87.2	$14.7	$10.3	$188.7
Waste	$0.7	$0.0	$0.9	$0.2	$0.4	$2.2
Unspecified	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**$162.0**	**$11.0**	**$145.5**	**$28.4**	**$31.7**	**$378.6**

Source: U.S. EPA analysis, 2002.

B7-1.2 Cost-to-Revenue Measure

a. Facility-level analysis

EPA estimates that the cost-to-revenue ratios at the facility-level for both analyzed cases of the waterbody/capacity-based option are low, similar to the proposed rule. Table B7-4 presents the distribution of facilities by range of the cost-to-revenue ratio, for both Option 1 and Option 2. Under both options, a vast majority of facilities incur compliance costs of less than one percent revenues. EPA estimates that under Option 1, 416 facilities, or 76 percent, would incur compliance costs of less than one percent of revenues; under Option 2, 444 facilities, or 81 percent, would incur compliance costs of less than one percent of revenues. Under Option 1, 67 facilities, or 12 percent, would incur compliance costs of greater than 3 percent of revenues. Fifty-one facilities, or 9 percent, would incur compliance costs of greater than 3 percent of revenues under Option 2. For both options, nine facilities are projected to be baseline closures and the revenues for one facility were unknown.

Table B7-4: Facility-Level Cost-to-Revenue Measure Waterbody/Capacity-Based Option

Annualized Cost-to-Revenue Ratio	All Track I (Option 1)		Track I and II (Option 2)	
	All Phase II	Percent of Total Phase II	All Phase II	Percent of Total Phase II
< 1.0 %	416	76%	444	81%
1.0 - 3.0%	57	10%	44	8%
> 3.0 %	67	12%	51	9%
Baseline Closure	9	2%	9	2%
n/a	1	0%	1	0%
Total[a]	**550**	**100%**	**550**	**100%**

[a] Individual numbers may not add up due to independent rounding.

Source: U.S. EPA analysis, 2002.

b. Firm-level analysis

Similar to the proposed rule, EPA estimates that the compliance costs for the waterbody/capacity-based option would also be low compared to firm-level revenues. Table B7-5 below summarizes the results of the cost-to-revenue measures by the domestic parent entity types. Under Option 1, 120 of the 131 unique parent entities that own the facilities subject to this rule would incur compliance costs of less than 1 percent of revenues; six entities would incur compliance costs of between 1 and 3 percent of revenues; three entities would incur compliance costs of greater than 3 percent of revenues; and two entities are projected to only own facilities that are baseline closures. Under Option 2, 101 entities would incur compliance costs of less than one percent of revenues; 14 entities would incur compliance costs of between 1 and 3 percent of revenues; and 14 entities would incur compliance costs of greater than 3 percent of revenues. Similar to Option 1, EPA estimates that two entities only own facilities that are baseline closures under Option 2.

Table B7-5: Firm-Level Cost-to-Revenue Measure Waterbody/Capacity-Based Option

Annualized Cost-to-Revenue Ratio	All Track I (Option 1)		Track I and II (Option 2)	
	All Phase II	Percent of Total Phase II	All Phase II	Percent of Total Phase II
< 1.0 %	120	92%	101	77%
1.0 - 3.0%	6	5%	14	11%
> 3.0 %	3	2%	14	11%
Baseline Closure	2	2%	2	2%
Total	**131**	**100%**	**131**	**100%**

Source: U.S. EPA analysis, 2002.

B7-1.3 SBREFA Analysis

The impacts on the small domestic parent entities would be very similar under both cases of the waterbody/capacity-based option, as presented in Table B7-6. Of the 28 entities EPA identified as small, 24 entities are expected to incur compliance costs of less than one percent of revenues under Option 1, and 25 entities under Option 2. EPA estimates that two entities would incur compliance costs of greater than 3 percent of revenues under Option 1. The cost-to-revenue ranges from 0.05 to 4.2 under Option 1. Under Option 2, only one entity is estimated to incur compliance costs of greater than 3 percent of revenues. The ratios range from 0.04 to 4.1 under this option.

Table B7-6: Impact Ratio Ranges by Small Entity Type Waterbody/Capacity-Based Option

Type of Entity	All Track I (Option 1)					Track I and II (Option 2)				
	Impact Ratio Ranges	0-1%	1-3%	>3%	Total	Impact Ratio Ranges	0-1%	1-3%	>3%	Total
Municipality	0.2-4.2%	15	2	2	19	0.1-4.1%	16	2	1	19
Municipal Marketing Authority	0.05-0.1%	2	-	-	2	0.04-0.1%	2	-	-	2
Political Subdivision	0.6-0.6%	1	-	-	1	0.5-0.5%	1	-	-	1
Rural Electric Cooperative	0.1-0.4%	6	-	-	6	0.1-0.4%	6	-	-	6
Total	**0.05-4.2%**	**24**	**2**	**2**	**28**	**0.04-4.1%**	**25**	**2**	**1**	**28**

Source: U.S. EPA analysis, 2002.

B7-2 Impingement Mortality and Entrainment Controls Everywhere Option (Option 3a)

This option would require the implementation of technologies that reduce I&E at all Phase II facilities without regard to waterbody type and with no site-specific compliance option available. EPA would set technology-based performance requirements under this alternative but would not mandate the use of any specific technology. Unlike the proposed option, this alternative would not allow for the development of BTA on a site-specific basis (except on a best professional judgment basis). This alternative would not base requirements on the percent of source water withdrawn or restrict disruption of the natural thermal stratification of lakes or reservoirs. However, it would impose entrainment performance requirements on Phase II facilities located on freshwater rivers or streams, and lakes or reservoirs. Finally, under this alternative, restoration could be used, but only as a supplement to the use of design and construction technologies or operational measures. This alternative would establish clear performance-based requirements that are simpler and easier to implement than those proposed and are based on the use of available technologies to reduce AEI.

B7-2.1 Compliance Costs

The estimated total annualized private post-tax cost of compliance for the impingement mortality and entrainment controls everywhere option is approximately $195 million.

Table B7-7 presents the total annualized private compliance cost by cost category and NERC region. The annualized cost by NERC region ranges from approximately $76,000 for facilities located in ASCC (Alaska Systems Coordinating Council) to $45 million for facilities located in SERC (Southwestern Electric Reliability Council). The capital technology cost which includes the cost of fine-mesh traveling screens and fish handling and return systems comprises $135 million of the total $195 million cost (or 70 percent). The costs of operating and maintenance and permitting are approximately $32 and $29 million, respectively. The annual energy penalty and one-time connection outage costs are not applicable to this regulatory option

because no facilities will be required to reduce intake capacity commensurate with the use of a closed-cycle recirculating cooling system.

Table B7-7: Private (Post-Tax) Annualized Compliance Costs by NERC Region (in millions, $2001)
Impingement Mortality and Entrainment Controls Everywhere Option

NERC Region	One-Time Costs		Recurring Costs		Permitting Costs	Total
	Capital Technology	Connection Outage	O&M	Energy Penalty		
ASCC	$0.0	$0.0	$0.0	$0.0	$0.1	$0.1
ECAR	$21.6	$0.0	$5.1	$0.0	$5.0	$31.7
ERCOT	$13.0	$0.0	$3.4	$0.0	$3.0	$19.3
FRCC	$8.0	$0.0	$2.0	$0.0	$1.8	$11.8
HI	$1.2	$0.0	$0.2	$0.0	$0.2	$1.6
MAAC	$10.5	$0.0	$2.1	$0.0	$2.2	$14.8
MAIN	$13.1	$0.0	$2.7	$0.0	$2.5	$18.3
MAPP	$5.6	$0.0	$1.3	$0.0	$2.5	$9.5
NPCC	$16.5	$0.0	$3.3	$0.0	$3.2	$23.0
SERC	$31.1	$0.0	$8.3	$0.0	$5.1	$44.5
SPP	$5.7	$0.0	$1.5	$0.0	$1.8	$8.9
WSCC	$8.4	$0.0	$1.6	$0.0	$1.9	$11.9
Total	**$134.6**	**$0.0**	**$31.6**	**$0.0**	**$29.2**	**$195.4**

Source: U.S. EPA analysis, 2002.

Table B7-8 presents total annual facility compliance costs by cost category and steam plant type. The annual compliance costs range from $900,000 for waste facilities to $96 million for coal facilities.

Table B7-8: Annualized Facility Compliance Costs by Steam Plant Type (in millions, $2001)
Impingement Mortality and Entrainment Controls Everywhere Option

Steam Plant Type	One-Time Costs		Recurring Costs		Permitting Costs	Total
	Capital Technology	Connection Outage	O&M	Energy Penalty		
Coal	$64.6	$0.0	$16.0	$0.0	$15.6	$96.2
Combined-Cycle	$2.2	$0.0	$0.6	$0.0	$0.9	$3.6
Nuclear	$28.3	$0.0	$5.8	$0.0	$2.9	$37.1
Oil/Gas	$39.1	$0.0	$9.1	$0.0	$9.4	$57.7
Waste	$0.3	$0.0	$0.1	$0.0	$0.4	$0.9
Unspecified	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**$134.6**	**$0.0**	**$31.6**	**$0.0**	**$29.2**	**$195.4**

Source: U.S. EPA analysis, 2002.

B7-2.2 Cost-to-Revenue Measure

a. Facility-level analysis

For the impingement mortality and entrainment controls everywhere option, EPA estimates that the compliance costs would be low compared to facility-level revenues. As shown in Table B7-9, out of the 550 in-scope facilities, 441 would incur annualized costs of less than one percent of revenues; 63 facilities would incur costs of between 1 and 3 percent; and 34 facilities would incur costs of greater than 3 percent. Eleven facilities are projected to be baseline closures, and for one facility, revenues are unknown.

Table B7-9: Facility-Level Cost-to-Revenue Measure
Impingement Mortality and Entrainment Controls Everywhere Option

Annualized Cost-to-Revenue Ratio	All Phase II	Percent of Total Phase II
< 1.0 %	441	80%
1.0 - 3.0%	63	11%
> 3.0 %	34	6%
Baseline Closure	11	2%
n/a	1	0%
Total[a]	**550**	**100%**

[a] Individual numbers may not add up due to independent rounding.

Source: U.S. EPA analysis, 2002.

b. Firm-level analysis

Compliance costs for the impingement mortality and entrainment controls everywhere option would also be low compared to firm-level revenues. Of the 131 unique parent entities that own the facilities subject to this rule, 102 entities would incur compliance costs of less than 1 percent of revenues; 13 entities would incur compliance costs of between 1 and 3 percent of revenues; and 14 entities would incur compliance costs of greater than 3 percent of revenues. Under the impingement mortality and entrainment controls everywhere option, two entities own only facilities that are baseline closures. Table B7-10 summarizes these results.

Table B7-10: Firm-Level Cost-to-Revenue Measure
Impingement Mortality and Entrainment Controls Everywhere Option

Annualized Cost-to-Revenue Ratio	All Phase II	Percent of Total Phase II
< 1.0%	102	78%
1.0 - 3.0%	13	10%
> 3.0 %	14	11%
Baseline Closure	2	2%
Total	**131**	**100%**

Source: U.S. EPA analysis, 2002.

B7-2.3 SBREFA Analysis

Under the impingement mortality and entrainment controls everywhere option, the overall annualized compliance costs that facilities owned by small entities are estimated to incur represent between 0.04 and 12.98 percent of the entities' annual sales revenues. Table B7-11 presents the distribution of the entities' cost-to-revenue ratios by small entity type. Of the 28 small entities, two would incur compliance costs of greater than three percent of revenues. Both of these entities are municipalities. Five entities would incur compliance costs of between one and three percent of revenues, while the remaining 21 entities would incur compliance costs of less than one percent of revenues.

Table B7-11: Impact Ratio Ranges by Small Entity Type
Impingement Mortality and Entrainment Controls Everywhere Option

Type of Entity	Impact Ratio Ranges	0-1%	1-3%	>3%	Total
Municipality	0.1-13%	12	5	2	19
Municipal Marketing Authority	0.04-0.3%	2	-	-	2
Political Subdivision	0.1-0.1%	1	-	-	1
Rural Electric Cooperative	0.1-0.6%	6	-	-	6
Total	**0.04-12.98%**	**21**	**5**	**2**	**28**

Source: U.S. EPA analysis, 2002.

B7-3 All Cooling Towers Option (Option 4)

This option would require all Phase II facilities having a design intake flow of 50 million gallons per day (MGD) or more to reduce the total design intake flow to a level, at a minimum, commensurate with that which can be attained by a closed-cycle recirculating cooling system. Of the 550 Phase II facilities, 124 already have a recirculating wet cooling system (e.g., wet cooling towers or ponds). These facilities would meet the requirements under this option unless they are located in areas where the director or fisheries managers determine that fisheries need additional protection. Therefore, under this option, 426 steam electric power generating facilities would be required to meet performance standards for reducing impingement mortality and entrainment based on a reduction in intake flow to a level commensurate with that which can be attained by a closed-cycle recirculating system.

B7-3.1 Compliance Costs

EPA estimates that the total annualized private post-tax cost of compliance for the all cooling towers option is approximately $2.32 billion. According to EPA's unit cost estimates, capital costs for individual high-flow plants to convert to wet towers generally ranged from $130 million to $200 million, with annual operating costs in the range of $4 million to $20 million.

Table B7-12 presents private annualized facility compliance costs by cost category and NERC region. The annualized cost by NERC region ranges from approximately $1 million for facilities located in ASCC (Alaska Systems Coordinating Council) to $660 million for facilities located in SERC (Southwestern Electric Reliability Council). The largest cost component would be the annual operating and maintenance expense which represents $1.1 billion (or 47 percent) of the total cost. EPA estimates the capital technology cost to be $685 million (or 30 percent) of the total cost. The energy effects associated with the installation of cooling towers would be $124 million (or 5 percent) for the connection outage and $362 million (or 16 percent) for the recurring energy penalty. The permitting costs are estimated to be $29 million (or 1 percent) of the total cost. The permitting costs under this regulatory option would be relatively low since the technology requirements would not include extensive site-specific determinations on the part of complying facilities.

Table B7-12: Annualized Facility Compliance Costs by NERC Region (in millions, $2001)
All Cooling Towers Option

NERC Region	One-Time Costs		Recurring Costs		Permitting Costs	Total
	Capital Technology	Connection Outage	O&M	Energy Penalty		
ASCC	$0.4	$0.0	$0.4	$0.1	$0.1	$1.0
ECAR	$106.8	$13.4	$183.4	$52.0	$5.0	$360.6
ERCOT	$58.6	$11.5	$114.0	$34.4	$3.0	$221.5
FRCC	$43.2	$7.4	$74.7	$23.4	$1.8	$150.4
HI	$6.2	$1.1	$6.3	$2.6	$0.2	$16.5
MAAC	$59.5	$6.7	$78.7	$19.2	$2.2	$166.3
MAIN	$53.3	$6.0	$80.6	$20.5	$2.5	$162.8
MAPP	$32.7	$4.8	$54.4	$15.0	$2.5	$109.5
NPCC	$99.0	$10.7	$143.6	$30.8	$3.2	$287.3
SERC	$165.3	$51.9	$299.9	$137.8	$5.1	$660.0
SPP	$13.8	$1.3	$26.4	$5.8	$1.8	$49.1
WSCC	$45.9	$8.8	$54.4	$20.4	$1.9	$131.5
Total	**$684.7**	**$123.8**	**$1,116.7**	**$361.9**	**$29.2**	**$2,316.4**

Source: U.S. EPA analysis, 2002.

Table B7-13 presents total annual facility compliance costs by cost category and steam plant type. The annual compliance costs range from $5 million for waste facilities to $1.2 billion for coal facilities.

Table B7-13: Annualized Facility Compliance Costs by Steam Plant Type (in millions, $2001)
All Cooling Towers Option

Steam Plant Type	One-Time Costs		Recurring Costs		Permitting Costs	Total
	Capital Technology	Connection Outage	O&M	Energy Penalty		
Coal	$319.7	$62.7	$575.7	$200.6	$15.6	$1,174.3
Combined-Cycle	$10.5	$0.9	$17.0	$1.8	$0.9	$31.1
Nuclear	$166.8	$45.6	$199.3	$94.4	$2.9	$509.0
Oil/Gas	$184.9	$14.7	$318.8	$64.6	$9.4	$592.4
Waste	$1.5	$0.0	$2.3	$0.5	$0.4	$4.7
Unspecified	$1.3	$0.0	$3.6	$0.0	$0.0	$4.9
Total	**$684.7**	**$123.8**	**$1,116.7**	**$361.9**	**$29.2**	**$2,316.4**

Source: U.S. EPA analysis, 2002.

B7-3.2 Cost-to-Revenue Measure

a. Facility-level analysis

The facility-level costs-to-revenue analysis for the all cooling towers option is presented below. The all cooling towers option results in high cost-to-revenue ratios at the facility level. This is not unexpected since under this option all in-scope facilities are required to reduce their intake capacity with the use of closed-cycle recirculating cooling systems. As shown below in Table B7-14, over 50 percent of the facilities would incur compliance costs of greater than 3 percent of revenues under this option. Two-hundred forty-one facilities, or 44 percent, would incur compliance costs of less than 3 percent of revenues. Nine facilities are projected to be baseline closures, and the revenues for one facility remain unknown.

Table B7-14: Facility-Level Cost-to-Revenue Measure All Cooling Towers Option

Annualized Cost-to-Revenue Ratio	All Phase II	Percent of Total Phase II
< 1.0 %	104	19%
1.0 - 3.0%	137	25%
> 3.0 %	298	54%
Baseline Closure	9	2%
n/a	1	0%
Total[a]	**550**	**100%**

[a] Individual numbers may not add up due to independent rounding.

Source: U.S. EPA analysis, 2002.

b. Firm-level analysis

Similar to the facility-level impacts, the cost-to-revenue ratios at the firm-level would also be high under the all cooling towers option. Thirty-six of the 131 unique domestic-parent entities would incur compliance costs of greater than 3 percent of revenues. The remaining 93 entities would incur compliance costs of less than 3 percent of revenues. Two of the entities own only facilities that are baseline closures under the all cooling towers option.

Table B7-15: Firm-Level Cost-to-Revenue Measure All Cooling Towers Option

Annualized Cost-to-Revenue Ratio	All Phase II	Percent of Total Phase II
< 1.0 %	73	56%
1.0 - 3.0%	20	15%
> 3.0 %	36	27%
Baseline Closure	2	2%
Total	**131**	**100%**

Source: U.S. EPA analysis, 2002.

B7-3.3 SBREFA Analysis

Under the all cooling towers option, EPA estimates that the 28 small entities would incur compliance costs of 0.05 percent to 33.63 percent of revenues. Over 46 percent, or 13 entities, would incur compliance costs of greater than 3 percent of revenues under the all cooling towers option. Eleven of these entities are municipalities. Table B7-16 presents the distribution of small entities by their entity type and estimated impact ratios under the all cooling towers option.

Table B7-16: Impact Ratio Ranges by Small Entity Type All Cooling Towers Option

Type of Entity	Impact Ratio Ranges	0-1%	1-3%	>3%	Total
Municipality	0.2-33.6%	4	4	11	19
Municipal Marketing Authority	0.1-2.4%	1	1	-	2
Political Subdivision	0.5-0.5%	1	-	-	1
Rural Electric Cooperative	0.1-5.9%	1	3	2	6
Total	**0.05-33.63%**	**7**	**8**	**13**	**28**

Source: U.S. EPA analysis, 2002.

B7-4 Dry Cooling Option (Option 5)

The dry cooling option requires all facilities that would install a cooling tower under the waterbody/capacity-based option to reduce their intake capacity to a level commensurate with the use of a dry cooling system.

B7-4.1 Compliance Costs

EPA estimates that the total annualized private post-tax cost of compliance with the dry cooling option is approximately $1.25 billion.

Table B7-17 presents private annualized facility compliance costs by cost category and NERC region for the dry cooling option. The annualized cost by NERC region ranges from approximately $0.1 million for facilities located in ASCC (Alaska Systems Coordinating Council) to $269 million for facilities located in FRCC (Florida Reliability Coordinating Council). The largest cost component would be the annual energy penalty associated with the dry cooling technology, which represents $554 million (or 44 percent) of the total cost. The dry cooling technology causes a reduction in unit efficiency due to increased turbine back-pressure of between 1.0 and 10.1 percent depending on the geographic region and generator type (for more detailed information on EPA's estimate of energy penalties see *Chapter B1: Summary of Compliance Costs*). EPA estimates the annualized capital technology cost and the annual operating and maintenance cost to be $490 million (or 39 percent) and $156 million (or 12 percent of total costs), respectively. The monthly connection outage and permitting costs are both estimated to be $26 million (or 2 percent of the total compliance costs).

Table B7-17: Annualized Facility Compliance Costs by NERC Region (in millions, $2001)
Dry Cooling Option

NERC Region	One-Time Costs		Recurring Costs		Permitting Costs	Total
	Capital Technology	Connection Outage	O&M	Energy Penalty		
ASCC	$0.0	$0.0	$0.0	$0.0	$0.1	$0.1
ECAR	$15.2	$0.0	$3.6	$0.0	$5.0	$23.7
ERCOT	$17.2	$0.4	$7.9	$29.4	$2.7	$57.5
FRCC	$73.9	$5.4	$27.0	$160.8	$1.5	$268.5
HI	$14.3	$1.1	$3.3	$27.7	$0.1	$46.4
MAAC	$94.6	$3.2	$29.7	$49.3	$1.7	$178.5
MAIN	$6.4	$0.0	$1.4	$0.0	$2.5	$10.3
MAPP	$2.0	$0.0	$0.4	$0.0	$2.5	$4.9
NPCC	$134.4	$4.6	$41.0	$73.4	$2.3	$255.7
SERC	$51.1	$3.5	$19.5	$105.3	$4.8	$184.2
SPP	$1.3	$0.0	$0.4	$0.0	$1.8	$3.5
WSCC	$80.0	$7.3	$22.2	$107.8	$1.4	$218.6
Total	**$490.4**	**$25.5**	**$156.3**	**$553.6**	**$26.3**	**$1,252.0**

Source: U.S. EPA analysis, 2002.

Table B7-18 presents total annual facility compliance costs by cost category and steam plant type. The annual compliance costs range from $3 million for waste facilities to $464 million for oil and gas facilities.

Table B7-18: Annualized Facility Compliance Costs by Steam Plant Type (in millions, $2001)
Dry Cooling Option

Steam Plant Type	One-Time Costs		Recurring Costs		Permitting Costs	Total
	Capital Technology	Connection Outage	O&M	Energy Penalty		
Coal	$118.8	$5.3	$38.4	$153.3	$15.0	$330.7
Combined-Cycle	$18.2	$0.4	$6.5	$13.0	$0.7	$38.9
Nuclear	$144.4	$14.3	$43.7	$210.2	$2.3	$414.9
Oil/Gas	$207.6	$5.4	$67.0	$176.2	$7.9	$464.1
Waste	$1.4	$0.0	$0.7	$0.9	$0.3	$3.3
Unspecified	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**$490.4**	**$25.5**	**$156.3**	**$553.6**	**$26.3**	**$1,252.0**

Source: U.S. EPA analysis, 2002.

B7-4.2 Cost-to-Revenue Measure

a. Facility-level analysis

The annualized cost-to-revenue ratios at the facility level for the dry cooling option are presented in Table B7-19. The ratios are higher under the dry cooling option than for the proposed rule. Of the 550 in-scope facilities, 73 facilities are expected to incur compliance costs of greater than 3 percent of revenues; 41 facilities would incur compliance costs of between 1 and 3 percent of revenues; and 425 facilities would incur compliance costs of less than one percent of revenues. Nine of the facilities are expected to be baseline closures, and the revenues for one facility remain unknown.

Table B7-19: Facility-Level Cost-to-Revenue Measure Dry Cooling Option

Annualized Cost-to-Revenue Ratio	All Phase II	Percent of Total Phase II
< 1%	425	77%
1.0 - 3.0%	41	7%
> 3.0 %	73	13%
Baseline Closure	9	2%
n/a	1	0%
Total[a]	**550**	**100%**

[a] Individual numbers may not add up due to independent rounding.

Source: U.S. EPA analysis, 2002.

b. Firm-level analysis

Impacts incurred at the firm level are similar to the facility-level impacts for the dry cooling option. EPA estimates 17 of the 131 unique domestic parent entities, or 13 percent, would incur compliance costs of greater than 3 percent of revenues. The remaining 112 entities would incur compliance costs of less than 3 percent of revenues under this option. Under the dry cooling option, two entities own only baseline closure facilities.

Table B7-20: Firm-Level Cost-to-Revenue Measure Dry Cooling Option

Annualized Cost-to-Revenue Ratio	All Phase II	Percent of Total Phase II
<1 %	95	73%
1.0 - 3.0%	17	13%
> 3.0 %	17	13%
Baseline Closure	2	2%
Total	**131**	**100%**

Source: U.S. EPA analysis, 2002.

B7-4.3 SBREFA Analysis

Under the dry cooling option, EPA estimates that the impacts on small entities would be minimal. Only one of the 28 entities determined to be small would incur compliance costs of greater than three percent of revenues. This one entity is a municipality. The remaining 27 small entities would incur compliance costs of less than three percent of revenues under the dry cooling option. The impact ratio ranges by small entity type for the dry cooling option are presented in Table B7-21.

Table B7-21: Impact Ratio Ranges by Small Entity Type Dry Cooling Option

Type of Entity	Impact Ratio Ranges	0-1%	1-3%	>3%	Total
Municipality	0.1-4.1%	16	2	1	19
Municipal Marketing Authority	0.04-0.1%	2	-	-	2
Political Subdivision	0.5-0.5%	1	-	-	1
Rural Electric Cooperative	0.1-0.4%	6	-	-	6
Total	**0.04-4.1%**	**25**	**2**	**1**	**28**

Source: U.S. EPA analysis, 2002.

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